



Why do we need advanced fuel separation technology?

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When recycling newspaper, glass, or plastic, we separate useful material from waste. So, we recycle used nuclear fuel by separating useful material (uranium, *transuranic elements*) from waste (fission products). This requires a technology that separates chemical elements.

Several countries such as France and the United Kingdom recycle used nuclear fuel. They use a process called PUREX, or “plutonium-uranium extraction.” PUREX dissolves used fuel in an acid and then extracts two separate products: pure plutonium and uranium. All else is waste. It works reliably.

Three issues with PUREX

The first concern is that other *transuranic elements* - neptunium, americium, and curium - are kept in the waste. These elements contain energy, are very toxic, and affect the design of geologic repositories if kept in the waste. So, we prefer to separate them from the waste and recycle them.

Second, the pure plutonium from PUREX can be used to make nuclear weapons. If other transuranic elements are kept with plutonium, it is yet more difficult to use in a weapon. So, we prefer to keep those elements with plutonium.

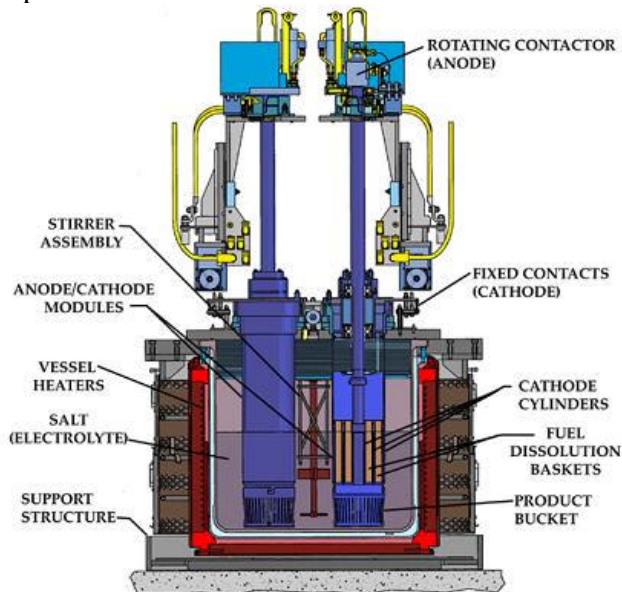
Third, PUREX dissolves only some fuel types, e.g., oxide fuel used in current power plants. It does not dissolve other types, e.g., some candidate fuels for the *Advanced Burner Reactor* (ABR) that are part of the GNEP. Other separation options can be developed and used for these other fuel types.

Alternative 1 – UREX+

UREX+ technology is a solution to the first two issues. It stands for “uranium extraction.” Pure plutonium is never separated. In the GNEP, all the other transuranic elements are kept with the plutonium. This minimizes waste and makes the material very difficult to use in a weapon.

Alternative 2 - Pyroprocessing

Pyroprocessing also solves the first two issues, but for different fuel types than UREX+. Rather than use a water-based acid, pyroprocessing dissolves used fuel in a chloride salt that is hot enough to melt. This does not work well for the oxide fuels in today’s nuclear power plants, but does work for a primary candidate ABR fuel - metal. Pyroprocessing extracts uranium, as well as all the transuranic elements together. Like UREX+, pyroprocessing does not separate plutonium.



Sketch of how pyroprocessing works

Benefits

The 2001 National Energy Policy recommends development of alternative separation technologies that reduce waste and enhance proliferation resistance, and sharing these technologies with international partners with highly developed fuel cycles. In developing UREX+ and pyroprocessing, the GNEP will improve advanced fuel cycle economics and waste management, while discouraging the accumulation of separated plutonium.